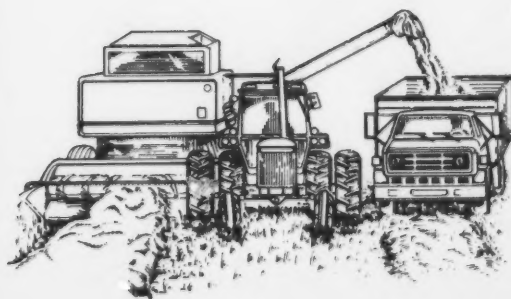




Saskatchewan
Agriculture

Economics
Branch

Farm
Management



Machinery Economics

Table of Contents

Page

I. Objectives of Machinery Management	1
II. Economic Principles Used in Machinery Management	1
- Fixed and Variable Costs	1
- Added Costs - Added Returns	1
- Substitution Principle	1
- Equal Marginal Returns Principle	1
- Opportunity Costs	2
- Present Value Analysis	3
III. Analyze Your Present Machinery Investment Position	3
IV. Substituting Machinery for Labour	4
V. Calculating Machinery Costs	4
Fixed Costs - Depreciation	4
- Investment	4
- Insurance and Housing	4
Variable Costs - Fuel	5
- Lubrication	5
VI. Determining Equipment Capacity and Size	6
- Calculating Field Capacity	6
- Determining Equipment Size	6
VII. Machinery Decisions	8
1. Buying Used Equipment	8
2. Whether or Not to Trade	8
- Calculating Income Tax Savings When Trading	10
3. Calculating a Rental Rate	10
4. Calculating a Custom Rate	11
5. Self Propelled vs PTO Implements	12
6. Owning vs Custom Hiring	12
7. Owning vs Leasing	13
8. Diesel vs Gasoline	13
9. Gear Up - Throttle Down	13
10. Machinery Sharing Arrangements	13

Foreword

Management decisions with respect to the selection and use of farm machinery can greatly affect the financial success of a farm. As the size of farms continues to grow and machinery investments increase, efficient management of equipment becomes more important. In 1987 in Saskatchewan, machinery and equipment investment was \$5918 million or 22% of total farm investment and machinery investment averaged \$120 per cultivated acre. In 1988 machinery cash expenses averaged \$11.83 per cultivated acre or 25% of total cash expenses.

Machinery management involves making decisions regarding machinery size and type, custom hiring, purchase of new or used equipment, machine replacement and the level of investment in machinery that can be justified. The basis for sound machinery management decisions is an accurate evaluation of expected benefits and costs of owning and operating machinery.

This publication examines the common machinery decisions farmers must make. It outlines the procedures which can be used to calculate machinery costs, and make machinery decisions.

Farm Management Section
Economics Branch
Saskatchewan Agriculture

I. Objectives of Machinery Management

1. Cost Control

High levels of machinery investment, or machinery in excess of requirements, increases costs. Higher costs result in reduced net farm income if production increases are insufficient to offset additional costs. Machinery organization should be such that farming operations get done on time and in the manner required — but with minimum cost. Consideration should also be given to expected future values of machinery.

2. Increased Production

Machinery organization affects both the amount and value of production. Timeliness of operations is critical particularly for seeding and harvesting. Inadequate machinery organization can be extremely costly in terms of its effect on production and net farm income. Important factors to consider include: size of machinery, reliability and alternative use of time.

3. Tax Management

Farmers frequently trade in machinery or buy more expensive machinery than required in order to reduce taxable income. In many instances this is false economy since added costs of owning the new machinery may be greater than the reduction in income tax. Decisions of this nature require a careful analysis of expected machine costs and tax savings.

4. Other Factors

Many farmers purchase machinery that is larger or newer than required, or which has features that may be somewhat of a luxury. Factors entering into these kinds of machinery decisions include health, age, personal satisfaction, convenience, other family members or operators using the machinery, and the farmer's equity position. In such cases, it is important to balance additional costs with benefits expected (both monetary and other). Alternative uses of the money

invested should also be considered — particularly for operators who are developing their farm business.

The starting point for machinery management decisions should be an evaluation of their effect on the farm's after tax net income. This involves considering added costs, added returns, and income tax benefits over the life or expected ownership period of the machine.

II. Economic Principles Used in Machinery Management

The need to become familiar with principles rather than depending on recommended practices lies in the fact that each farm situation is unique and slightly different from any other. General recommendations cannot be used to answer such common questions as "will it pay to own a baler?". An understanding of economic principles permits their application to a specific farm problem where a blanket recommendation may not apply.

Economic principles are useful tools for appraising the economic effect of various alternatives facing the farm manager. Once understood, principles will guide your approach to the problem and thus, save time in farm planning by assuring that only the relevant problem is considered, and that it is approached in a logical manner.

1. Fixed Costs and Variable Costs

One of the most important economic concepts from the standpoint of day to day farm management decision making is the distinction between fixed and variable costs.

Fixed costs are annual overhead or ownership costs that do not vary with production. In the short run, such as the next production period, many costs become committed for the production period. Therefore, for many day to day decisions, the fixed costs are irrelevant. Variable or operating costs are costs that vary with production or use.

If a farm practice or activity will more than cover its variable costs, then it pays to continue the activity in the short run. Since fixed

costs do not change in the short run, and since adjustments to reduce such costs may not be practical, income will be improved as long as the variable costs are more than covered. This also means that a farm manager should not abandon an activity if it appears to be losing money when all costs are taken into account. Sound management requires knowing when to disregard fixed costs in making management decisions.

Suppose a poor wheat crop is standing in the field that will yield only four bushels per acre and wheat is \$3.00 per bushel. If the total cost of producing wheat is \$100.00 per acre, money will be lost on the wheat crop. Under these circumstances the objective should be to minimize losses rather than maximize profits. If the four bushels of wheat at \$3.00 per bushel or \$12.00 per acre will more than pay the harvesting cost, then the wheat should be harvested. If the harvesting cost is \$8.00 per acre, then the fixed costs at this point are \$92 per acre, but since the variable costs are less than the return, the expenditure for harvesting should be made.

2. Added Costs - Added Returns Principle

The added return associated with an investment must be greater than the added cost to increase net returns. When considering an additional investment in machinery the important consideration is whether the added returns from the increased production is sufficient to offset the extra costs associated with the change. **It is profitable to add inputs until the added return equals the added costs.**

3. Equal Marginal Returns Principle

The investment must be the most profitable use of available funds. A producer should not spend money in one enterprise or practice if it would yield a higher return in another use. With limited capital, he may not purchase new seed even though it would return \$1.30 for each \$1.00 spent if he has an alternative such as a fertilizer application that would return \$1.50 for each \$1.00 spent. Even though purchasing new seed

was profitable in this case, with limited capital it was less profitable than applying fertilizer.

Another alternative decision would be to purchase a new tractor rather than continue to use the old tractor. The return on investment must be calculated on the new tractor to compare it with the other alternatives. If there is no return on investment as suggested from the calculations in the Whether or Not to Trade Section, then the decision to apply additional fertilizer would be appropriate.

Stated simply, **all farm resources will be at the most profitable combination when the last dollar spent in one use will yield a return equal to the last dollar spent in other uses.** The objective is not just to make a profit, but to make the greatest profit from the farm's limited resources. Therefore, sound management requires that limited capital be invested where the greatest returns can be realized from it.

It may be that no factors are limiting. Then each enterprise or practice could be pushed to the point where added cost equals added returns. In practice, however, either land, labour, capital or management will limit production on any one product and a decision must be made as to which ones to cut back and which ones to invest in to maximize profit.

4. Substitution Principle

This principle provides the logic for determining the least cost method of production.

Decisions relating to substitution involve finding the combination that will give the lowest cost of production for the task in question — whether it is substituting one feed for another, machinery for labour or other substitutions. There are two parts to these problems, the physical relationship (ratio of substitution) and the economic relationship (price ratio).

To arrive at the least cost combination requires a knowledge of the substitution of labour for machinery. It also depends on interest on machinery investment and cost of labour assuming that skilled labour is available. In situation A the lowest cost combination is achieved with the low machinery investment and higher labour requirement. In situation B and C the lowest cost is achieved with higher machinery investment and lower labour requirement.

In general, the principal states that if the amount of output stays the same it pays to add a resource as long as its value is less than the value of the resource replaced. If there is a one to one substitution between resources, you would use only the cheapest resource. If the ratio of

substitution is not one to one, normally you would calculate the cost of each combination and then choose the combination with the lowest total cost.

The least cost combination does not necessarily mean the most profitable. Several other considerations should be considered in conjunction with the substitution principle, such as the time it takes to produce a certain output, the quality of the product, or the amount of labour involved in using each factor of production.

5. Opportunity Cost Principle

The opportunity cost principle states **that the cost of using a resource is the return that would be obtained from using it in its most profitable alternative use.**

Every resource has an alternative opportunity cost. When charging for the use of capital, your own money should be charged at the return you could receive if you invested it in its most profitable use. When you feed a bushel of grain or a ton of hay, the cost to the animals eating this should be the return you could have received had you used it in another manner — selling it — regardless of what it cost to put up the feed. The value of labour used on your farm should be the same as what it could be drawing as a wage from a job in a nearby town or doing custom work for your neighbour.

The following example illustrates the substitution principle:

Machinery Investment and Labour Combinations to Operate a 1200 Acre Farm With a 40 Cow Beef Herd

Investment in Machinery	Hours of Labour	Total Cost*		
		A	B	C
\$185000	2500	44325	52755	56825
\$150000	3000	42750	54450	57750
\$115000	3500	41175	56145	58675

Situation A: Interest at 12%, labour at \$7/hour.
Situation B: Interest at 8%, labour at \$12/hour.
Situation C: Interest at 12%, labour at \$12/hour.

*Total cost includes labour plus all fixed costs of machinery ownership, depreciation with 13 year average life, investment and insurance and housing.

Bad decisions in farm planning are made by assuming that because an investment shows an absolute money profit above its cash costs, it should be pursued. You should always look at an investment on the opportunity cost basis. If money is being invested in machinery, charge interest rates you could earn in the best alternative investment such as savings bonds, term investments, or repaying loans.

The important point is that you should be trying to obtain the maximum return from any resource. If you don't use it for the best alternative then you are giving up some extra return.

6. Present Value Analysis

Present Value Analysis or discounting is used to establish the present value of future income or cost, or the future value of present income or cost. With an opportunity cost of 10% you could invest a dollar today and it would earn \$.10 in one year. Therefore a dollar today is worth \$1.10 one year from now or \$.90 today is worth \$.99 in one year.

The concept of present value analysis is to bring two or more choices to a common base, be it present or future for comparison. Some equipment dealers offer better deals at certain times of the year when business is slower. By using present value analysis we can compare the discount offered to the return you could realize on your money by investing it and buying the machine later in the year.

Example I: you have the opportunity to purchase a machine in January for \$10,000 and leave it idle until July. Is this a good investment? In six months \$10,000 invested at 9% would earn $1/2 \text{ year} \times 9\% \times \$10,000 = \$450$. If you had to pay more than \$10,450 for the machine in July, you would be better off to buy it in January.

Example II: A farmer has two offers regarding the purchase of a 30' hoe press drill. Dealer 1 offers him \$1400 off the price of \$35000 for the new drill and \$10000 trade-in value for his old drill if he trades now, June 30.

Calculations:		
Purchase price		35,000
Less discount	\$1,400	
Less trade	10,000	
	\$11,400	11,400
Cash difference		23,600
Plus insurance costs for half year		75
Cost if purchased on June 30		\$23,675

Dealer 2 offers to take the old drill now, June 30, for a credit of \$10,000 and will deliver the new drill six months later for \$35,000.

Calculations:	Purchase price	\$35,000
	Less trade	10,000
Cash difference payable		25,000

In order to compare we must put the two offers on the same basis by using present value analysis. Using the following table:

	Present Value of \$1.00 Due in the Future							
	Interest Rate (Compounded Semi-annually)							
Time Period	5	6	7	8	9	10	11	12
1/2 Year	.9756	.9709	.9662	.9615	.9569	.9524	.9479	.9434

Present Value of Cash Difference paid to Dealer 2 on June 30 at 10%
 $= 25,000 \times .9524 = \$23,810$

At 10% opportunity cost the deal offered by Dealer 1 is cheaper by
 $23,810 - 23,675 = \$135.00$

Present Value of Cash Difference paid to Dealer 2 on June 30 at 12%
 $= 25,000 \times .9434 = \$23,585$

At 12% opportunity cost the deal offered by Dealer 2 is cheaper by
 $\$23,675 - \$23,585 = \$90.00$

III. Analyze Your Present Machinery Investment Position

- (1) Take an inventory of your farm machinery and equipment. List each item and its cash sale value. The sum of all equipment values will be your total machinery investment.
- (2) Calculate your machinery investment per acre by dividing your machinery investment by your number of cultivated acres.
- (3) Calculate your machinery cash operating costs. Total your costs of fuel oil and lubricants, repairs and maintenance, custom work and machinery rental for all equipment including half tons. Divide this by your cultivated acres and compare with the following Saskatchewan averages determined from the 1988 Top Management Program.
- (4) Machinery interest cost is the average machinery investment for the year multiplied by your opportunity cost of money. Pick an interest rate between what you could invest your money at, and what you are paying on your farm loans (Top Management Program uses 10%). Depreciation

Saskatchewan Top Management Program 1988*

	All Farms \$/ac	Brown Soil Zone \$/ac	Dark Brown Soil Zone \$/ac	Black Soil Zone \$/ac
Equipment Cash Expenses	11.83	\$9.59	\$10.30	\$15.42
Interest and Depreciation on Equipment Investment	27.32	22.18	26.20	32.44
Total Machinery Expenses	39.15	31.77	36.50	47.86
Total Fixed and Cash Expenses	73.96	60.22	66.44	93.37
Total Machinery Expenses as % of Total Fixed and Cash Expenses	53%	53%	55%	51%

$$\begin{aligned}\text{Machinery Investment Cost} &= \frac{(\text{Beginning Value Machinery} + \text{Ending Value Machinery})}{2} \times \text{Int. Rate} \\ &= \frac{(100,000 + 101,000)}{2} \times 10\% = \$10,050\end{aligned}$$

$$\begin{aligned}\text{Machinery Depreciation} &= (\text{Beginning Value} + \text{Purchases}) - (\text{Ending Value} + \text{Sales}) \\ &= (100,000 + 20,000) - (101,000 + 3,000) = 120,000 - 104,000 = \$16,000\end{aligned}$$

Add your Machinery Investment and Depreciation to get a total investment cost of $\frac{\$26,050 + \$26,050}{1,000 \text{ cult/ac}} = \$26.05/\text{ac}$

is the loss in value of your total line of machinery from the beginning to the end of the year. Subtract the year end value of all machinery and sales during the year from the beginning year value plus purchases of machinery.

* The Top Management Program provides to the farm manager a detailed financial analysis of his farm business as well as a financial projection for the next five years. This program uses a forward planning computer model developed by the University of Saskatchewan.

Compare your Machinery Investment and Depreciation with the Saskatchewan 1988 Top Management average in the above table.

IV. Substituting Machinery for Labour

Much of the machinery purchased today replaces labour. This allows a farm operator to expand his operation or diversify into other areas of a farm without reducing his leisure time or making him dependent on hired labour. It also allows more leisure time if expansion is not desirable.

The main goal of any business decision is to minimize costs and maximize profits. Minimum labour may not always mean minimum

costs. You should assess your own situation and attempt to strike a balance between machinery investment and labour use so that costs are minimized. The breakeven point for least cost combinations is where the average extra investment cost for the machine equals the value of labour saved. This varies with:

- (1) How much labour the machine will replace.
- (2) The value of the labour replaced.
- (3) The hours of annual use and the number of useful years of the machine.

If you invest in buildings and equipment that are designed to replace labour you will be more efficient in your labour use, but what happens to the labour which has been replaced. In many cases there may not be an alternate use for this labour. Since the labour was saved by an extra expenditure on buildings or machinery, then you may have less net income than before. Substituting machinery for labour can usually only be justified if you have

an alternate use for your labour, if you can cut down on hired labour or if you're prepared to put a high value on your leisure time.

V. Calculating Machinery Costs

The following approach outlines how to calculate machinery costs.

Fixed Costs

Some costs occur regardless of the amount of use of a machine, and are calculated on an annual basis. These annual costs are normally referred to as fixed or ownership costs and make up 60-65% of total machinery costs. These costs include depreciation, interest cost, insurance and housing cost.

Depreciation refers to the loss in value of a machine which occurs due to wear and obsolescence. Depreciation can also be considered as a fund setup to replace the original value of an asset in a certain number of years. The formula for calculating an average annual depreciation for a machine is:

$$\text{Depreciation} = \frac{\text{Original Cash Cost} - \text{Cash Sale Value}}{\text{Years of Use}}$$

Investment cost represents the cost of borrowing money, or the interest which could be earned if the capital were invested elsewhere. It is determined by multiplying the average annual investment by the interest rate as follows:

$$\text{Investment Cost} = \frac{\text{Original Cash Cost} + \text{Cash Sale Value} \times \text{Interest Rate}}{2}$$

trading machinery, buying used or new machinery, custom hiring, or leasing machinery, or whether joint ownership of machinery is warranted.

Insurance and housing costs allow for the risk of equipment loss, the cost of housing and for a possible higher depreciation and repair cost which may result if equipment is not housed. The effect of housing benefits should be considered in estimating trade-in values and repair costs. An allowance of 1% of original cash cost usually covers annual insurance and housing costs.

$$\text{Insurance and Housing} = \text{Original Cash Cost} \times 1\%$$

Variable Costs

Some costs occur only when a machine is used. These costs include fuel, lubrication, repairs and labour. Since these costs vary with the amount of use, they are expressed on an hourly basis and are generally referred to as variable costs.

Fuel costs can be estimated on an hourly basis (i.e. litres per hour x price per litre). Lubrication costs vary between machines. A suggested guide is 35c/hour for each 100 horsepower.

Repair costs per hour can be determined by estimating the total repair cost of the machine, and then dividing by the hours of use. Repair costs and hours of use may be on an annual, lifetime or other time period basis. Repair costs can be based on a percent of original cost. The Saskatchewan Agriculture publication Farm Machinery Custom and Rental Rate Guide, appendix F lists the average repair rates for various farm equipment.

$$\text{Repair Allowance} = \frac{\text{Total Repair Cost}}{\text{Hours Use}}$$

Labour may be charged as either the cost of hired labour, or the estimated value of the owner's labour. Although labour is not a machine cost, it should be taken into account in comparing different sizes of machines and the calculation of custom rates.

Total Machine Costs

Using the costing procedures outlined in the preceding section, one can determine total costs of equipment on an annual, hourly, or on an acreage basis. These costs can then be used as a guide in management decisions involving

Calculation of Machinery Costs (Example)

The following example illustrates how to calculate machinery costs using the preceding costing approach. Calculations are made for annual and per hour costs of a 150 hp tractor.

Assumptions:

Original Cash Cost - 60,000; depreciation lifetime - 13 years; annual hours use - 600 hours; annual repair rate - 5%; interest charge - 10%.

Fixed Costs (per year):

Depreciation	= $\frac{\$60,000 - \$6,000}{13}$	= \$4,154
Investment Cost	= $\frac{\$60,000 + \$6,000}{2} \times 10\%$	= \$3,300
Insurance and Housing	= $\$60,000 \times 1\%$	= 600
Total Fixed Costs Per Year		= \$8,054

$$\text{Fixed Costs Per Hour} = \frac{8,054}{600} = \$13.42 \text{ (A)}$$

Variable Costs (per hour):

Fuel - 32 litres x \$.29/l	9.28
Lubrication - \$.35/100 hp x 150 hp	.53
Repairs = $5\% \times \$60,000 = 3,000$	5.00
	$\frac{600 \text{ hours}}{600}$
Total Variable Costs per Hour	14.81 = 14.81 (B)
Total Costs per Hour (A + B)	\$28.23

Total Costs Per Year:

$$\begin{aligned} &= \text{Total Fixed Costs/Year} + (\text{Total Variable Costs/Hour} \times \text{Annual Hours Use}) \\ &= \$8,054 + (\$14.81 \times 600) = \$16,940 \end{aligned}$$

The following example illustrates how to calculate machinery costs for a pull type combine.

Assumptions: original cash cost \$65,000; depreciation lifetime - 12 years; annual hours of use 150; annual repair rate 7%; interest charge 10%; powered by a 150 hp tractor.

Fixed Costs (per year)

$$\text{Depreciation} = \frac{65,000 - 6,500}{12}$$

$$= \$4,875$$

minutes. Assume 4 turns at 10 seconds each 15 minutes - 40 seconds = 14.3 minutes

$$\text{Investment Cost} = \frac{65,000 + 6,500}{2} \times 10\%$$

$$= \$3,575$$

(1) Calculate the number of acres per hour the machine will cover.

Insurance and Housing \$65,000 x .01

Total Fixed Costs Per Year

$$\frac{650}{\$9,100}$$

Acres per hour =

Total Fixed Costs Per Hour

$$\frac{9,100}{150} = \$60.67 \text{ (A)}$$

$$\frac{29 \text{ ft} \times 5 \text{ miles/hr}}{8.25} = 17.58 \text{ ac/hr}$$

Variable Costs (per hour)

$$\text{Repairs} = \frac{65,000 \times .07}{150 \text{ hours}}$$

$$= \$30.33$$

(2) Determine the portion of an hour the machine is used.

$$\frac{14.3 \text{ minutes}}{60 \text{ minutes}} = .238 \text{ hour}$$

Total Variable Costs Per Hour

$$\frac{\$30.33}{\$30.33 \text{ (B)}}$$

Total Costs Per Hour (A + B)

$$\$91.00$$

(3) Multiply the number of acres per hour (1) x the portion of an hour of use (2) acres covered in 14.3 minutes = 17.58 ac/hr x .238 hour = 4.2 The answer is 4.2 acres

Total Costs Per Year

$$\begin{aligned} &= \text{Total Fixed Costs/Year} + (\text{Total Variable Costs/Hour} \times \text{Annual Hours Use}) \\ &= \$9100 + (30.33 \times 150) \\ &= 13,650 \end{aligned}$$

Cost Per Acre

$$= \frac{\text{Total Cost of 150 hp Tractor/hr} + \text{PTO Combine/hr}}{\# \text{ Acres/Hour}}$$

$$= \frac{28.23 + 91.00}{8 \text{ Acres/Hour}} = \$14.90/\text{acre}$$

If field operations were 100% efficient with no time spent turning, no overlap, no stopping then the following formula could be used to calculate acres per hour.

Acres per hour =

$$\frac{\text{width (ft)} \times \text{speed (mph)}}{8.25^*}$$

VI. Determining Equipment Capacity and Size

Excess machinery capacity diminishes profits. Careful thought as to need for and the proper size of farm equipment you can utilize most efficiently is important when purchasing equipment.

Calculating Field Capacity

Determining the number of acres covered in a particular distance and the number of acres covered in a certain time period are required when calibrating equipment.

The following formula can be used to calculate the number of acres covered.

Acres covered =

$$\frac{\text{width of machine (ft)} \times \text{miles distance}}{8.25^*}$$

Question: If you have a field one mile long and make a round with a 30 ft. machine (using 29 ft. due to 1 ft. overlap), how many acres have you covered?

Acres covered =

$$\frac{29 \text{ ft.} \times 2 \text{ miles}}{8.25^*} = 7.03 \text{ acres}$$

Question: How many acres do you cover in 15 minutes at 5 miles per hour with a 30 foot machine using 29 ft.? First estimate the time spent turning and deduct it from the 15

*1 acre = 1 mile long by 8.25 feet wide.

In reality when doing field operations it is necessary to stop from time to time to grease, check the machine and make adjustments. Time is also lost due to turning and overlapping. For these reasons field operations are not 100% efficient. Seeding and harvest operations are less efficient than tillage operations because time is spent loading the drill with seed or unloading the combine hopper.

The following field efficiencies are used in the Saskatchewan Agriculture publication Farm Machinery Custom and Rental Rate Guide.

field operation
tillage
seeding and harvesting
no till seeding

field efficiency
82.5%
69%
63%

The following formula can be used to calculate acres per hour.

$$\text{Acres per hour} = \frac{\text{width (ft.)} \times \text{speed (mph)} \times \% \text{ field efficiency}}{8.25^*}$$

For example, how many acres per hour would you seed at 5.5 miles per hour with a 40 foot drill.

$$\begin{aligned} \text{Acres per hour} &= \\ \frac{5.5 \times 40 \times .69}{8.25} &= 18.4 \end{aligned}$$

Determining Equipment Size

Selecting the right size machine to do the job in the time you have available and still keep the cost down is not an easy task. If you buy too large a machine you give yourself added leeway in time to get the job done but must bear the increased cost of investment and depreciation.

The size of machine you need depends on how much time you have to do the job. Since seeding and combining are critical, these implements should be sized first. The following procedure can be used to determine equipment size for a particular farm.

(1) first determine the number of days available for the critical operations of seeding and combining. Information could be obtained from the weather office or from local farmers.

- Assume - 1000 cropped acres
- combining must be done in 14 days at 10 hours per day
 - seeding must be done in 15 days at 10 hours per day
 - swathing must be done in 10 days at 10 hours per day

* 1 acre = 1 mile long by 8.25 ft. wide.

(2) Calculate combine size required
Required combine capacity per hour =

$$\frac{\# \text{ acres crop}}{\# \text{ hours avail.}} = \frac{1000}{140} = 7.14 \text{ ac/hr}$$

A pull type combine with 50 inch cylinder will combine approximately 8 acres per hour providing the swath is large enough to keep the combine full.

(3) Calculate swather size
Required swather capacity per hour =

$$\frac{\# \text{ acres crop}}{\# \text{ hours avail.}} = \frac{1000}{100} = 10 \text{ acres/hr}$$

Required swather width =

$$\begin{aligned} &\frac{\text{acres/hour} \times 8.25 \text{ ft.}}{\text{speed (mph)} \times \text{field efficiency}} \\ &= \frac{10 \text{ acres/hour} \times 8.25}{5 \times .69} = \frac{82.5}{3.45} \end{aligned}$$

$$= 23.9 \text{ ft.}$$

A 24 or 25 foot swather would do the job in 100 hours and provide a large enough swath for the combine. Consideration should be given to the width of swath needed to keep the combine full or the number of acres per hour of combine capacity may be reduced.

(4) Calculate the size of seeding equipment.

Seeding is to be done using an air seeder including cultivator followed approximately one day later by a harrow packing operation. The same tractor will be used for both operations. 150 hours are available in total. 100 hours are available for seeding and 50 hours are available for harrow packing.

Required seeding capacity per hour =

$$\frac{\# \text{ acres crop}}{\# \text{ hours avail.}} = \frac{1000}{100} = 10 \text{ acres/hr}$$

Required air = $\frac{\text{acres/hr} \times 8.25 \text{ ft.}}{\text{Seeder width speed(mph)} \times \text{field eff.}}$

$$= \frac{10 \times 8.25 \text{ ft.}}{5.5 \times .69} = \frac{82.5}{3.795} = 21.7 \text{ ft.}$$

Required harrow packing capacity per hour

$$\frac{\# \text{ acres crop}}{\# \text{ hours avail.}} = \frac{1000}{50} = 20 \text{ acres/hr}$$

Required harrow packer width =

$$\begin{aligned} &\frac{\text{acres/hr.} \times 8.25 \text{ ft.}}{\text{speed (mph)} \times \text{field eff.}} \\ &= \frac{20 \times 8.25 \text{ ft.}}{5.5 \times .69} = 36 \text{ ft.} \end{aligned}$$

An air seeder of 22 feet and a harrow packer 36 to 40 feet in width would enable the farmer to seed in 150 hours.

Other considerations: if a farmer uses the same tractor for seeding and harrow packing, he may consider the merits of having a larger harrow packer and a smaller air seeder since the cost/ft is less for the harrow packer than the air seeder, and he could still stay within the 150 hour limit.

(5) Calculate Tractor Size

The tractor should be sized according to the maximum horsepower requirement of the pull type equipment on the farm. The combine with a 50 inch cylinder would require approximately 140 horsepower. The horsepower requirements of the air seeder and heavy duty cultivator according to the 1987 Guide to Farm Practice, page 52, are 5.8hp/ft. Air seeder hp requirements = 22 ft x 5.8 hp/ft = 128 hp. Since the combine horsepower requirements are the highest, the combine will determine the size of tractor at 140 horsepower. Purchasing the 140 horsepower tractor would enable you to pull a 24 foot air seeder or a 56 foot harrow packer if you wanted and could afford some excess capacity in these machines.

The following tables appear in the 1987 Guide to Farm Practice:

Tillage Machinery — Power Requirements

Machine	Depth mm	Average Speed km/hr	Average Power Requirement (drawbar)*	
			kW/m	(hp/ft)
Cultivator, heavy duty (with harrows)	80	8.0	14.2	(5.8)
Field Cultivator (with harrows)	60	10.0	8.8	(3.6)
Blade Cultivator	75	8.0	14.2	(5.8)
Rod Weeder	60	8.0	6.1	(2.5)
Tandem Disc (heavy)	100	8.0	23.1	(9.4)
Discer	75	8.0	9.8	(4.0)
Harrows (tine)	N/A	8.0	1.8	(0.75)

* Average tractor power requirements are suitable for determining tractor size based on Nebraska pto power data. They are obtained from PAMI draft data and include factors for tractive efficiency and operation at 80% of maximum pto power.

Seeding Machinery — Power Requirements

Machine	Average Speed km/hr	Average Power Requirements kW/m width (hp/ft)
Discer	8.0	9.8 (4.0)
Double-disc press	8.0	6.1 (2.5)
Hoe press drill	8.0	9.6 (3.9)
Pneumatic seeder	8.0	12.2 (5.0)
Packers	8.0	4.2 (1.7)

* Average power requirements are adjusted to enable direct comparison to pto power published in Nebraska Test data.

VII. Machinery Decisions

1. Buying Used Equipment

Farmers often consider the purchase of used equipment in order to reduce the average costs of operation. The initial years of ownership are quite costly in terms of interest and depreciation charges. The elimination of the investment tax credit for new machinery purchases will reduce the benefit of purchasing new equipment. Purchasing good quality used equipment will lower your machine investment and in some cases make machinery ownership possible.

Whether or not you will gain by the practice of buying used equipment will depend on your ability to evaluate the condition of the used machine, the price, and your mechanical ability to maintain used machinery.

2. Whether or Not to Trade

There is no simple formula to determine when to trade equipment. Most people make a decision by weighing the costs of keeping the old machine versus the costs of the new machine. The factors which normally affect the decision of whether or not

to trade are the cost of expected repairs, business losses due to downtime, reliability of the old machine, finance charges and tax savings on the new machine.

From an economic standpoint, the time to trade an old machine is when the annual cost of the old equipment is greater than the annual cost of the new machine.

The following worksheet will help you to determine whether or not to trade one machine on another machine. Begin by indicating the type of machine and a description of the old and new machines, the list price of the new machine and the ownership time period considered.

1. Enter the cash difference paid for the new machine in line one.
2. Enter the cash value of the trade in on line 2. This value can be determined by machinery ads in farm papers.
3. Enter the current value of the new machine lines 1 + 2 (\$40,000 + \$30,000 = \$70,000).
4. Enter the expected cash value at the end of the period. The example assumes \$15,000 for the old machine and \$35,000 for the new machine. These amounts will vary depending on the make of machine and options included.
5. The loss in value during the period for the old machine is \$30,000 - \$15,000 = \$15,000, for the new tractor \$70,000 - \$35,000 = \$35,000.
6. The old tractor will require a motor overhaul if it is kept and the overhaul will cost \$7,000. Future repairs on the old tractor are estimated at \$5,000 over the next 6 1/2 years. The tractor needs new tires all around including rear duals and the estimate is \$2,200.

The estimate of repairs for the new tractor should be similar to the repairs for the first 6 1/2 years on the tractor you now own assuming it is a similar tractor.

Year 1 + 2, all repairs covered by warranty
 Years 3 to 6 1/2, the following was spent on the current tractor:

alternator	\$300
batteries	300
water pump overhaul	200
fan belts	25
two tires repaired	400
other miscellaneous	
(air and trans. filter)	475
Total	\$1700

The finance charges on the cash difference of \$40,000 would be calculated as follows assuming a 12% interest rate and principal payments of \$6,150 per year.

Year	Beginning Year Balance	Annual Interest	Principal Payment at Year End
1	40,000	4,800	6,150
2	33,850	4,062	6,150
3	27,700	3,324	6,150
4	21,550	2,586	6,150
5	15,400	1,848	6,150
6	9,250	1,110	6,150
7	3,100	372	3,100
Total		18,102	40,000

The additional insurance charges on the cash difference of \$40,000 at \$2.50/\$1000 insurance = \$100 per year x 6 1/2 years = \$650

Worksheet to Determine Whether or Not to Trade

Old Machine Tractor Description 150 hp
 New Machine Tractor Description 155 hp List Price 80,000
 Ownership Time Period 6 1/2 years*
 Alternative: Keep old tractor for 6 1/2 years or buy a new tractor and keep it for 6 1/2 years.

	old machine	new machine	old machine	new machine
1. Cash difference for new machine	xxxxx	\$40,000	xxxxx	xxxxx
2. Current value of old machine	\$30,000	xxxxx	xxxxx	xxxxx
3. Current value of new machine 1 + 2	xxxxx	70,000	xxxxx	xxxxx
4. Expected cash value at end of period	15,000	35,000	xxxxx	xxxxx
5. Loss in capital value (current-4)	15,000	35,000	xxxxx	xxxxx
6. Cash adjustments				
- overhaul	7,000			
- future repairs	5,000	1,700		
- finance charges on cash diff.	xxxxx	18,102	xxxxx	xxxxx
- additional insurance charges on cash diff.	xxxxx	650	xxxxx	xxxxx
7. Other considerations				
Downtime and reduced efficiency from old machine (\$1000./yr)	6,500	xxxxx	xxxxx	xxxxx
Tax savings from purchase of new machine (deduct)	xxxxx	(9,840)**	xxxxx	()
Fuel savings from new machine (deduct)	xxxxx	(377)***	xxxxx	()
8. Total costs for the period (5 + 6 + 7)	33,500	45,235	xxxxx	xxxxx
9. Years in the period	6.5	6.5	xxxxx	xxxxx
10. Average cost per year 8:--9	5,155	6,959	xxxxx	xxxxx
11. The new machine has added costs of \$1,804/year				

* For this example, 6 1/2 years was chosen as the ownership time period because Saskatchewan Agriculture considers 7,800 hours or 13 years at 600 hours of use per year as the Farm Service Life for tractors and 6 1/2 years would be one-half the normal Farm Service Life.

** For 1988 a 3% Investment Tax Credit of \$2100 would be included, this would result in the added cost of the new machine being \$1561/year.

*** The fuel savings estimated from the use of the new tractor are 1/3 litre/hour x \$.29/l of diesel x 6.5 years x 600 hours/year = \$377.00.

7. The down time and reduced efficiency from the old machine was estimated at \$1,000 per year for 6 1/2 years. This would be the equivalent of losing a grade (\$.25) on 160 acres of wheat at 25 bushels per acre each year.

Calculating Income Tax Savings When Trading

The tax savings from the purchase of the new machine would be calculated as follows, assuming a 28% tax rate and additional Capital Cost Allowance (CCA) of \$40,000.

An average tax rate of 28.0% would correspond to a taxable income of \$1 to 27,500 for 1988.

8. The total costs for the period are the total of all costs under #5, #6 and #7. Deduct negative amounts for tax and fuel savings for the new machine indicated by brackets.

9. The number of years in the period are 6 1/2. We are considering keeping the old tractor for another 6 1/2 years versus the costs for the first 6 1/2 years of a new tractor.

10. The average cost per year for the new and old machine is calculated by dividing the total costs for the period by the number of years in the period. For the new tractor
 $\$45,362 / 6.5 \text{ years} = \$6,980/\text{year}.$

11. Subtract the average costs of the old from the new machine to determine the difference in annual costs. In this example the new machine has added costs of \$6,980 - \$5,155 = \$1,825/year.

To further analyze the impact of this decision on your farm financial situation, it would be wise to determine the impact of the new tractor purchase on your cash flow.

3. Calculating a Rental Rate

The following example illustrates how to calculate a rental rate for a 130 hp tractor with original cost of \$56,900, depreciation lifetime of 13 years, 600 annual hours of use, 5% annual repair rate, and a 10% interest charge on investment.

Year	Beginning CCA	CCA Rate	CCA Claimed	Average Tax Rate	Tax Savings
1	\$40,000	30% $\times$ 1/2 **	\$6,000	28.0%	1,680
2	34,000	30%	10,200	28.0%	2,856
3	23,800	30%	7,140	28.0%	1,999
4	16,660	30%	4,998	28.0%	1,399
5	11,662	30%	3,499	28.0%	980
6	8,163	30%	2,449	28.0%	686
6 1/2	5,714	30% $\times$ 1/2 ***	857	28.0%	240
Total					9,840

** Depreciable assets purchased after November 12, 1981 are subject to half the applicable capital cost allowance in the year of purchase.

*** Capital cost allowance is calculated for one-half year.

Fixed Costs (per year)

$$\text{Depreciation} = \frac{\text{Orig. Cash Cost} - \text{Cash Salvage Value}}{\# \text{ years use}} = \frac{56,900 - 5,690}{13} = \$3939.00 \text{ (A)}$$

$$\text{Investment} = \frac{\text{Orig. Cash Cost} + \text{Cash Salvage Value}}{2} \times \text{Int. Rate} = \frac{56,900 + 5,690}{2} \times 10\% = 3130.00 \text{ (B)}$$

$$\text{Insurance and Housing} = \text{Orig. Cash Cost} \times .01 = 56,900 \times .01 = 569.00 \text{ (C)}$$

$$\text{Total Annual Fixed Costs (A + B + C)} = 7638.00$$

$$\text{Fixed Costs per Hour} = \frac{7638}{600} = 12.73 \text{ (D)}$$

Variable Costs (per hour)

$$\text{Repair Costs per Hour} = \frac{\text{Orig. Cash Cost} \times \text{Average Annual Repair Rate}}{\text{Annual Hours}} = \frac{56,900 \times .05}{600} = 4.74 \text{ (H)}$$

$$\text{Basic Rental Costs/Hour (D + E)} = 17.47 \text{ (F)}$$

$$\text{Margin 15\% of Basic Rental Cost/Hour (Fx.15)} = 2.62 \text{ (G)}$$

$$\text{Rental Rate per Hour (F + G)} = \$ 20.09$$

The Saskatchewan Agriculture publication Farm Machinery Custom and Rental Rate Guide contains a Rental Rate Calculation Worksheet which can be used to calculate a rental rate for a specific machine.

4. Calculating a Custom Rate

The following example illustrates how to calculate a custom rate for a 130 hp tractor with original cost of \$56,900, depreciation lifetime of 13 years, 600 annual hours of use, 5% repair rate, a 10% interest charge on investment, and labour at \$9.00/hour.

Fixed Costs (per year)

$$\text{Depreciation} = \frac{\text{Original Cash Cost} - \text{Cash Salvage Value}}{\# \text{ Years Use}} = \frac{56,900 - 5,690}{13} = \$3939.00 \text{ (A)}$$

$$\begin{aligned} \text{Investment} &= \frac{\text{Original Cash Cost} + \text{Cash Salvage Value}}{2} \times \text{Int. Rate} \\ &= \frac{56,900 + 5,690}{2} \times 10\% = 3130.00 \text{ (B)} \end{aligned}$$

$$\text{Insurance and Housing} = \text{Original Cash Cost} \times .01 = 56,900 \times .01 = 569.00 \text{ (C)}$$

$$\text{Total Annual Fixed Costs (A + B + C)} = 7638.00 \text{ (D)}$$

$$\text{Fixed Costs per Hour} = \frac{7638}{600} = 12.73 \text{ (E)}$$

Variable Costs (per hour)

$$\text{Fuel 28 Litres/Hour} \times \$.29 = 8.12 \text{ (F)}$$

$$\text{Lubrication } \frac{\$.35}{100 \text{ hp}} \times 130 \text{ hp} = .46 \text{ (G)}$$

$$\text{Repairs} = \frac{\text{Orig. Cash Cost} \times \text{Average Annual Repair Rate}}{\text{Annual Hours}} = \frac{56,900 \times .05}{600} = 4.74 \text{ (E)}$$

$$\text{Total Costs per Hour (no labour) (E + F + G + H)} = 26.04 \text{ (I)}$$

$$\text{Labour Costs} = 9.00 \text{ (J)}$$

$$\text{Basic Custom Work Rates } \$/\text{hr (I + J)} = 35.04 \text{ (K)}$$

$$\text{Margin 15\% of Basic Custom Work Rates (K} \times .15) = 5.26 \text{ (L)}$$

$$\text{Custom Rate } \$/\text{hr (K + L)} = \$ 40.30$$

The following example illustrates how to calculate a custom rate for a 27 ft. cultivator with original cost of \$13,700, depreciation lifetime 15 years, 250 annual hours of use, 5.5% repair rate, 10% interest, labour at \$9.00/hr. The cultivator is pulled by the 130 hp tractor in the preceding example.

Fixed Costs (per year)

$$\text{Depreciation} = \frac{\text{Original Cash Cost} - \text{Cash Salvage Value}}{\# \text{ Years Use}}$$

$$= \frac{13,700 - 1,370}{15} = \$822.00 \text{ (A)}$$

$$\text{Investment} = \frac{\text{Original Cash Cost} + \text{Cash Salvage Value} \times \text{Int. Rate}}{2}$$

$$= \frac{13,700 + 1,370 \times 10\%}{2} = 754.00 \text{ (B)}$$

$$\text{Insurance and Housing} = \text{Original Cash Cost} \times .01 = 13,700 \times .01 =$$

$$137.00 \text{ (C)}$$

$$\text{Total Annual Fixed Costs} = 1713.00$$

$$\text{Fixed Costs per Hour} = \frac{1713}{250} = 6.85 \text{ (D)}$$

Variable Costs (per hour)

$$\text{Repair Costs per Hour} = \frac{\text{Orig. Cash Cost} \times \text{Average Annual Repair Rate}}{\text{Annual Hours}}$$

$$= \frac{13,700 \times .055}{250} = 3.01 \text{ (E)}$$

$$\text{Machine Total Costs (D + E)} = 9.86 \text{ (F)}$$

$$\text{Power Unit Total Costs per Hour} = 26.04 \text{ (G)}$$

$$\text{Labour Costs} = 9.00 \text{ (H)}$$

$$\text{Basic Custom Work Rate (F + G + H)} = 44.90 \text{ (I)}$$

$$\text{Margin 15\% of Basic Custom Work Rate (I} \times .15) = 6.74 \text{ (J)}$$

$$\text{Custom Rate \$ / hr (I + J)} = 51.64 \text{ (K)}$$

$$\text{Work Rate} = 13.5 \text{ ac/hr (L)}$$

$$\text{Calculated Custom Rate (K/L)} = \frac{\$51.64}{13.5 \text{ ac/hr}} = \$3.83/\text{ac}$$

Fixed Costs Per Year	SP Combine	PTO Combine
Depreciation	\$ 7875.00	\$ 4875.00
Investment	5775.00	3575.00
Insurance and Housing	1050.00	650.00

Total Combine Fixed Costs/Year	14,700.00	9100.00
Total Combine Fixed Costs/ac	12.25	7.58
Tractor Fixed Costs/ac	—	.67

A. Total Fixed Costs/ac	12.25	8.25
----------------------------	-------	------

Variable Costs per Hour (including labour)

Fuel	8.70	—
Lubrication	.53	.16
Repairs	35.52	19.50
Variable Tractor Costs (150 hp)	—	14.81
Labour	9.00	9.00

Total Variable Costs/Hour	53.75	43.47
------------------------------	-------	-------

B. Total Variable Costs/acre	5.97	5.43
Total Cost per Acre (A + B)	\$18.22	\$13.68

6. Owning vs Custom Hiring

The following formula can be used to determine the number of acres required to justify ownership.

$$\text{Number Acres to Justify Ownership} = \frac{\text{Total Fixed Costs per Year}}{\text{Custom Rate} - \text{Op. Costs per Acre}}$$

Consider the \$65,000 pull type combine in the preceding example. Assume the custom combining rate is \$12.00/acre.

Number Acres to Justify Ownership of the PTO combine

$$= \frac{\$9,900}{\$12.00 - \$5.43} = \frac{9900}{6.57} = 1507 \text{ acres crop per year}$$

The Saskatchewan Agriculture publication Farm Machinery Custom and Rental Rate Guide contains a Custom Rate Calculation Worksheet which can be used to calculate a custom rate for a specific machine.

5. Self Propelled vs Pull Type Equipment

The following example illustrates a method of comparing self propelled and pull type equipment. Assume that both combines are of the same make and size. The original cash cost of the self propelled combine is

\$105,000. The original cash cost of the pull type is \$65,000.00, 12 year life, 10% interest rate. The capacity is nine acres per hour for the self propelled and 8 acres per hour for the pull type. 1200 acres of crop are harvested with each machine. Combine average annual repair rate of 4.5% for 150 hours on PTO, 133 hours on SP. Tractor fixed costs include only the extra features purchased specifically for use with the PTO combine. Since virtually all 2 wheel drive tractors have PTO, the tractor fixed costs include only the \$6,000.00 cost of the power shift.

Consider the \$105,000 self propelled combine in the preceding example. Assume the custom combining rate is \$12.00 per acre.

Number Acres to Justify Ownership of the SP Combine

$$= \frac{14,700}{12.00 - 5.97} = \frac{14,700}{6.03}$$

= 2438 acres crop per year

Other considerations: It may make economic sense to sell your combine and hire a custom combiner but (1) can you rely on the custom operator to arrive when your crop is ready to be harvested? (2) will the custom operator attempt to minimize grain losses to the same extent that you would with your own machine? (3) what is the value of your labour?

7. Owning vs Leasing

With changing technology and spiraling costs, the amount of capital needed to maintain an adequate line of equipment represents a significant percentage of total investment. Many farmers are considering alternatives to ownership such as short term rental arrangements and long term leases.

Some of the reasons for leasing equipment are:

- provides fixed cost financing
- preservation of credit
- simplified budgeting and accounting
- flexibility in machinery management
- flexibility of leases
- capital conservation

Some of the disadvantages of leasing are:

- less gain in equity
- loss of tax credits
- not all equipment is suited to leasing
- restricted flexibility in long term leasing
- no protection under the Agricultural Implements Act

For a complete discussion of leasing, advantages and disadvantages, income tax treatment of leases and a present value analysis of owning vs leasing obtain a copy of the Saskatchewan Agriculture publication "Leasing Farm Machinery" from your local ag rep.

8. Diesel vs Gasoline

The following example shows how to calculate the breakeven number of acres required to justify the purchase of a diesel motor on a 25 ft self propelled swather.

Number of Ownership Hours to Justify a Diesel Swather

$$= \frac{\text{Added Fixed Cost/Year of Diesel Motor}}{\text{Savings in Operating Costs/Hour of Diesel Motor}}$$

$$= \frac{\$650/\text{Year}^*}{\frac{20\text{I Gas} \times \$0.31 - 14\text{I Diesel} \times \$0.29}{\$650.00/\text{Year}}}$$

$$= \frac{\$2.14/\text{Hour}}{\$2.14/\text{Hour}}$$

$$= 304 \text{ Hours}$$

Number of Acres to Justify Ownership of a Diesel Swather = 304 x 11.5 ac/hr
= 3500 ac/yr

*The added investment for a diesel motor on a diesel powered swather is \$5200.00. The added fixed costs are calculated as follows:

Depreciation =	$\frac{5200 - 520}{15 \text{ years}}$	=	\$312.00
Investment =	$\frac{5200 + 520 \times .1}{2}$	=	\$286.00
Insurance and Housing =	$5200 \times .01$	=	52.00
Total Added Fixed Costs		=	\$650.00

9. Gear Up Throttle Down

Agriculture engineers have found that by doing things that cost you nothing you can cut fuel use by up to 18 percent. During 1982 and 1983 the effects of proper ballasting and gear up throttle down was tested by the University of Saskatchewan. By changing to a higher gear and throttling down under light loads, fuel efficiency is increased. For loads in the 50% of full load range, gearing up and reducing engine speeds by 25 percent from rated engine rpm results in close to optimum fuel efficiency. When using the gear up throttle down technique the most important thing to remember is not to overload or lug the engine. Visible black smoke may be one indicator of an overloaded diesel engine. To determine if the engine is overloaded open the throttle, if the engine readily picks up speed, it's not overloaded. University of Saskatchewan engineer, Dr. Gerald Zoerb, said the average data from all tests shows a 18% improvement in fuel efficiency.

A 10% saving in fuel consumed by a 170 horsepower tractor would amount

to 3.9 litres per hour or \$1.13/hour at \$.29/l of diesel.

10. Machinery Sharing Arrangements

Because of the increasing cost of farm equipment and low net returns many farmers are considering sharing machinery as a method of reducing the machinery investment per acre. If you currently share equipment or are considering a sharing arrangement the following points should be kept in mind.

(a) Have a written agreement of understanding.

(b) Either share the machinery investment in the same proportion as the machine is used, or calculate a year end settlement for investment cost.

Example: A forage harvester is used jointly by two farmers to put up silage. When purchased the original cost of the forage harvester was \$15,000, A puts up 100 tons, B puts up 200 tons. The investment in the forage harvester should be shared as follows:

A's investment $\frac{100 \text{ tons} \times \$15,000}{300 \text{ tons}} = \$5,000$ (1/3 share)

B's investment $\frac{200 \text{ tons} \times \$15,000}{300 \text{ tons}} = \$10,000$ (2/3 share)

If after several years farmer A increases his herd and now requires 200 tons of silage annually and the forage harvester is now worth \$12,000 the following adjustment should be made.

Present ownership A - $\frac{1}{3} \times 12,000 = \$4,000$
 B - $\frac{2}{3} \times 12,000 = \$8,000$

Fair Investment A - $\frac{200T \times 12,000}{400T} = \$6,000$
 under new
 circumstances

B - $\frac{200T \times 12,000}{400T} = \$6,000$

Farmer A should pay farmer B \$2,000 and he would then own a 50% share in the forage harvester.

If you don't share machinery investment in proportion to the usage of machines, the following method can be used to calculate a year end investment cost settlement. Assume interest = 10%, A and B each put up 200 tons of silage, the forage harvester is worth \$12,000, A owns a 1/3 share and B owns a 2/3 share in the forage harvester.

	Number tons silage	Actual investment cost	Fair investment cost	Equalization actual - fair investment cost
A	200T	$\$12,000 \times \frac{1}{3} \times 10\%$ = \$400	$200T \times \frac{\$1200}{400T} = \$600$	- \$200
B	200T	$\$12,000 \times \frac{2}{3} \times 10\%$ = \$800	$200T \times \frac{\$1200}{400T} = \$600$	+ \$200
Total	400T	\$1200	\$1200	

At the year end settlement, A would pay B \$200 to compensate for B's greater investment in the forage harvester than the use that B made of the machine.

c) Share the operating costs in proportion in the use of the machine. One method of sharing fuel and repair costs where several machines are shared in a grain operation would be on the basis of cultivated acres. The following example shows how three farmers would calculate a year end settlement for fuel and repairs in a machinery sharing agreement assuming the machine ownership is in proportion to acres farmed.

	Cultivated acres	Fuel and repairs actual spent	Fuel and repairs fair split	Year End settlement
Farmer A	900(A)	\$12,000(E)	$\$10,800(I) \left[\frac{AxH}{D} \right]$	+ 1200(E-I)
Farmer B	900(B)	\$11,000(F)	$\$10,800(J) \left[\frac{BxH}{D} \right]$	+ 200(F-J)
Farmer C	1200(C)	\$13,000(G)	$\$14,400(K) \left[\frac{CxH}{D} \right]$	-1400(G-K)
Total	3000(D)	\$36,000(H)	\$36,000	

To settle up at year end Farmer C would pay \$200 to B and \$1200 to A.

d) Clearly outline the responsibilities, privileges, maintenance procedures and use practices when setting up a machinery sharing agreement.

References

Farm Machinery Economic Decisions by R. R. Schwart, University of Illinois, College of Agriculture, Co-operative Extension Service. December 1972. Modern Concepts of Farm Machinery Management, by Wendell Bowers, 1970. Machinery Financial Management by Terrence T. W. King, Alberta Agriculture Farm Machinery Costs, Alberta Agriculture

